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***Skills Dynamics and (the Need for) Longitudinal Data***

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**ABSTRACT**

Skills dynamics analyses are frequently carried on the basis of synchronic data, namely the one provided by firms' Employment Records. As this kind of surveys are designed to depict formal employment, not only separation spells but also most infra annual flows are not taken into consideration. Neither is there any data on vocational training and job experience, as well.

Empirical evidence we have been obtaining from some previous research points both to the importance skills development strategies are taking along those non-employment spells and also to some qualification strategies which encompass both job-to-job and job-to-unemployment (inactivity) /unemployment (inactivity)-to-job flows.

Also, analyses usually developed generally fail to take into consideration the influence exerted by economic cycles upon individual trajectories, in which skills development decisions are also supposed to play a major role.

Therefore, we'll try to stress the adequacy both of duration models and longitudinal data on which those models should rely in order to shed light on the above mentioned features.

**Key words:** skills dynamics; longitudinal data; duration models; economic cycle; policy implications; Portugal.

**JEL Code:** J24, J63, J64

## 1. INTRODUCTION

Our main purpose with this paper and Seminar is to share our concern about the statistical databases available for the study of skill development patterns along life cycles and their impact upon active life cycle trajectories.

Along the past three years we have been carrying some research in this field which enabled us to shed some light on this issue but also made us question the adequacy of Employment Administrative Records (Quadros de Pessoal) databases for that purpose and feel the need for an adequate individual longitudinal database to go deeper in this research subject.

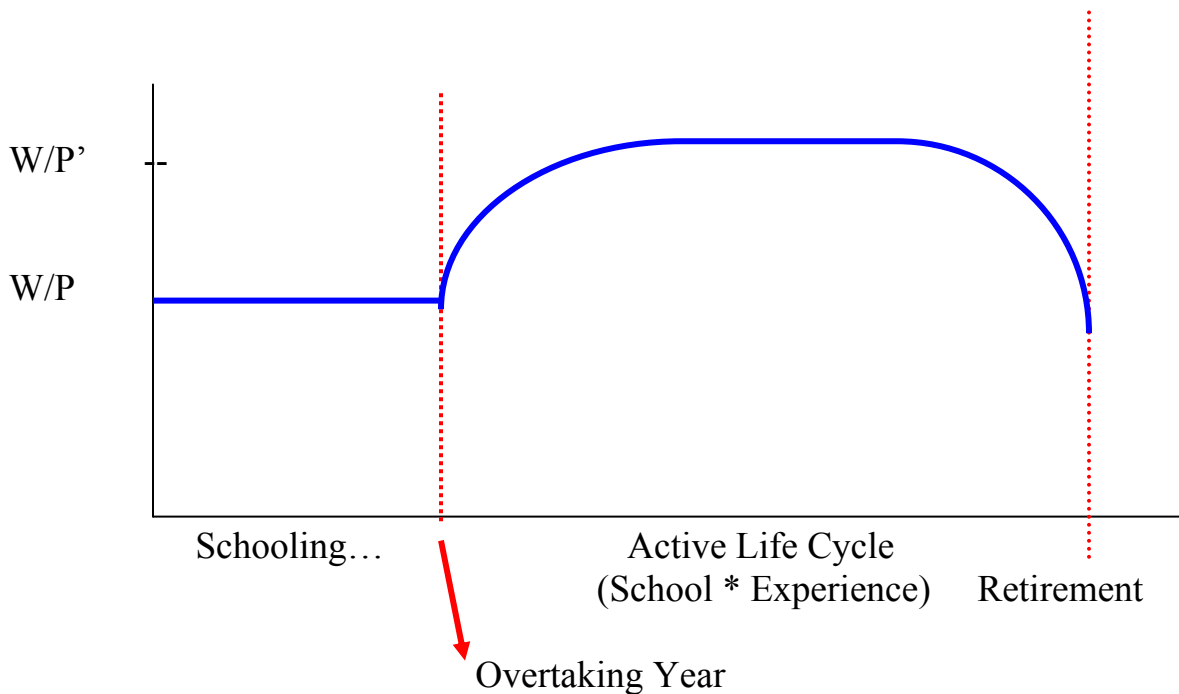
Therefore this paper is organised as follows: after the Introduction (Section 1.), Section 2. discusses the concept of skills (and not the one of ‘qualifications’) and skill dynamics impact upon life cycle trajectories on the basis of some of the most important theoretical approaches in this field; Section 3. resumes the most important results of our previous research; Section 4. sets the requirements databases shall meet in order to be able to adequately depict skills development patterns and Section 5. presents some further research topics and policy implications.

On the basis of the approach we are developing we would like to be able to help decision makers to address some of the more stringent Portuguese labour market problems, such as: training programmes able to compensate for skills obsolescence along employment separations; insufficient knowledge on infra annual mobility flows; higher education

graduates' (re)employment and the corresponding job matching quality; identifying some of the leading factors behind “chimney” and eviction effects, in order to control for long term unemployment in an hysteresis framework.

## 2. THEORETICAL FOUNDATIONS

Weiss and his followers' contributions<sup>1</sup> to Human Capital theory questioned Mincer's contribution and main developments. According to Mincer's, skills development occur life long under a continuous and uninterrupted path, following the well known U-shaped curve depicted in the Figure:



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<sup>1</sup> (Weiss, 1986).

This representation fits quite adequately the general labour market trends before the first important economic turmoil that followed the first oil shock. But it is no longer adequate after that.

The hypothesis under which schooling and, more generally, formal education only exerts influence on the initial path of the individual life cycles, before the insertion into the labour market, becomes also more and more subject to criticism because it fails to take into account individual actual qualification strategies and opportunities. As a matter of fact, trajectories reversal processes are becoming more and more frequent, in opposition to the previously established assumptions under which a linear and irreversible sequence linking schooling-occupational insertion-employment/activity-retirement was supposed to hold; the main reason for this more recent pattern has to do with the growing perception that the return to school and to formal education, after any eventual breakdown in education/training by the time of labour market entry, would be of great help in improving the actual occupational status<sup>2</sup>.

That is why the new approaches on life cycle and human capital theory started to incorporate life cycle breaks and reversibility in their analytical framework, which has to be seen as a major theoretical turning point since it allows for obsolescence to intervene in skills dynamics processes.

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<sup>2</sup> For Portugal, and according to OECD analyses and findings, there seems to be the case, as internal rates of return related to secondary and tertiary education levels were by far larger than the ones in any one of the other countries considered for the same period of time (OECD, 1997). Notwithstanding, cyclical downturns and their impacts upon employability should compel us to readdress these results.

From Weiss (1986) the stock of human capital growth rate along the life cycle ( $dK/dt$ ) can be written as:

$$\frac{dK}{dt} = K_0 h g_1(K_t) - \delta g_2(K_t) \quad (1)$$

The first term, in the right hand side, represents the qualification constitution processes, whose strength rises with  $h$ , the share of working time associated with occupational qualifying experience, given an initial stock,  $K_0$ ; and the second term has to do with qualification obsolescence, due to unemployment and/or inactivity spells, in which qualification will depreciate at a rate equal to  $\delta$ , unless some compensation processes, like schooling and/or vocational training attendance, will take place.

As to  $g_1$  and  $g_2$ , they are defined as follows:

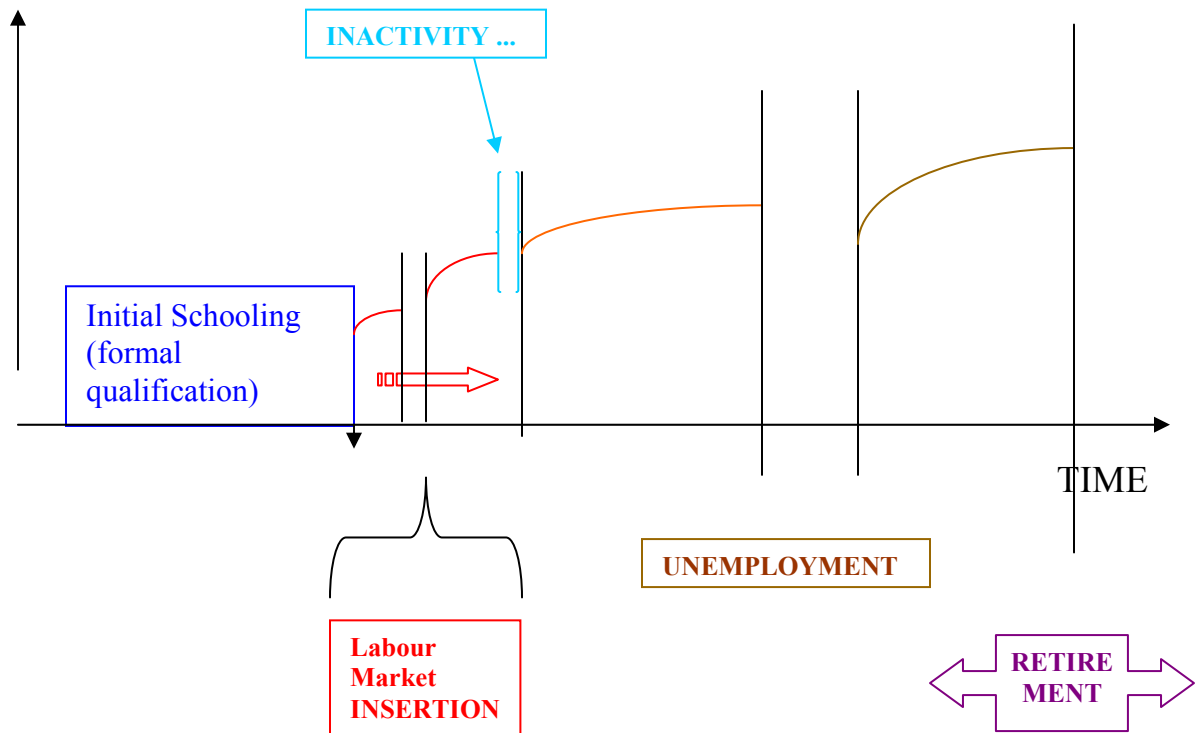
$$g_1(K) > 0, \quad g_1'(K) < 0, \quad g_2(0) = 0, \quad g_2'(K) > 0 \quad (2)$$

meaning that, for a given  $h$ , the human capital growth rate grows with the previously obtained capital stock but at a decreasing rate and that obsolescence is time increasing.

Definitions in (2) mean that both the occupational skills reinforcement and the acquiring of new knowledge will tend to become stronger depending on the initial stock of individual qualifications; and also that the occupational experience will eventually tend to become weaker whenever

that initial stock reveals to have been meaningfulness. They also stand for the obsolescence processes that take place whenever the job is characterised by repetitive, fragmented routine functions and so there is no room to apply the previously acquired knowledge<sup>3</sup>. Obsolescence of qualifications will take place at an increased depreciation rate ( $\delta$ ) the longer the breakdown spells, due to unemployment or inactivity ( $h = 0$ ).

The life cycle pattern is now more like the one depicted in the following figure<sup>4</sup>:



So, more realistic assumptions were thereafter considered:

- Life cycle theories explicitly consider employment or activity separations and their analytical framework encompass not only

<sup>3</sup> This means a small value of  $h$  in (1).

<sup>4</sup> Chagas Lopes (2003).

employment/activity spells but also transitional periods in which skills obsolescence would inevitably take place in spite of some compensation strategies that quite frequently take place as, for instance, vocational training attendance or educational programmes continuation or finishing;

- Life cycle turning points are now considered not as time discrete ‘shots’ but as processes, taking time to occur and solve, and characterised by reversibility and recurrence in employee’s (and in employers...) occupational outcomes and strategies;
- In what labour market insertion is concerned, instead of Mincer’s *overtaking year*, there is now scope for a quite heterogeneous time spell, allowing for different strategies and outcomes from the labour market new joiners such as: small duration probation spells intertwined with unemployment/inactivity, changing search strategies, attending further education (a Master, for instance...) and so on<sup>5</sup>;
- Reinsertion situations after unemployment deserve as well a more acute analysis, namely by taking into consideration a large scope of transition situations, depending on the intensity and duration of income support programmes which could take place during each unemployment spell (Kazepov, 1998);
- Demand side factors [firms’ strategies concerning both strength and pertinence of working experiences and their heterogeneity and (re)employability] become as important as the supply side [workers human capital investment strategies along the life cycle];

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<sup>5</sup> For a noticeable research and description of the insertion processes faced by Portuguese graduates see (Alves, 2004).

- As a by product of these more realistic approaches, the true meaning of rates of return should also be reconsidered in accordance with changing economic and labour market cycles.

Going deeper into the analysis of skills dynamics we introduce some further criticism on Weiss's assumptions.

To begin with, nothing allows us to accept that the qualification and skill outcomes associated with the occupational experience provided by each job should be directly proportional to a given share of the working time, as h. The heterogeneity in job complexity contents among firms, as a result of a diversity of factors like labour organisation, technological innovation, corporate culture, individual and groupware learning inside the organisation, should be considered, as it strongly affects their relative contribution to the individual qualification and skills throughout the quite heterogeneous levels of effective knowledge they actually provide.

The spell of time each worker needed to get acquainted to job specific skills requirements sums up a diversity of cognitive, relational and social competences and so it seems reasonable to take it as a proxy for the occupational experience. However this proxy strongly depends not only on own abilities, commitment, and stock of formal qualifications but mostly on firm's work organisation, labour qualification policies and general human resources strategies.

The failure to adequately taking into account the qualification effects induced by the demand side stands as one of the leading criticism arguments



addressed towards both human capital and life cycle theories. Individual autonomy, in which concerns life cycle human capital reinforcement strategies still holds, indeed, in many approaches. Nevertheless, it will be enough to consider equation (1) to get aware of the leading and decisive role played by demand – both by firms and the labour market – in those strategies and decision making processes: actually, despite an eventually great amount of human capital one would achieve both previously to the entry into the labour market and during the employment spells, the intensity of  $g_2$  and the correlated obsolescence rate may well be large enough to cancel out the positive effects induced by  $K_0 h g_1(K_t)$ .

Despite the effort each individual would carry along her/his life cycle in order to improve qualification, it is not taken for granted that there will be made effective use of the corresponding outcome. As a matter of fact, both job contents and demands, responsibility levels and reward policies inside firms quite often neglect the improvement in employees' qualifications and skills.

And, what is even worse, this kind of misusing does take place even when the firm co-finances individual qualification, namely throughout vocational training. Whenever there is not any training strategy inside the firm, vocational training programmes outcomes are not quite often made full use. Low job complexity, for example, make their potential qualification effects remain mostly outside job contents and labour organisation. All of these features must then be taken into consideration in the analyses of the qualification trajectories, such as the present one.

This is why the Portuguese statistical system needs to conceive an adequate methodology to be addressed both to firms and employees in order to assess the degree of effective worker's skills endogeneisation by firms and therefore define a more precise proxy for occupational experience.

Before that, we must also make clear the conceptual approach of qualification we are working with. Indeed, we always mean by 'qualification' the actual and effective skills whether hold by the individual or demanded by the job. This is not the usual approach. Generally, research uses the conventional or formal qualification concepts<sup>6</sup>, meaning the firms and organisations codification of the actual qualification by means of the occupational grades hierarchy, and the corresponding wage levels.

In Portugal, that usual option implies, however, some severe analytical restrictions, because the current occupational grades codification<sup>7</sup> does not allow any hierarchical ordering of the individual and job real qualifications, even in what concerns their simplest feature – school levels. In fact, that codification encompasses a mix among actual qualification levels and hierarchical and management grades, making almost impossible, for instance, any comparison among technical staff, 'blue-collars' and supervisors from the point of view of their real qualifications. It also takes almost exclusively into account the nature and demands of jobs and organisational departments inside the firm and neglect the outcomes of any

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<sup>6</sup> See, for instance, Hecq *et alii* (1994).

<sup>7</sup> In use, namely, in the leading Portuguese labour market statistics, as the *Employment Records* by the Ministry for Labour and Social Solidarity.

individual effort to upgrade actual qualification<sup>8</sup>, most particularly in the situations in which such an effort would not prove to be directly useful – and then appropriated – by the firm.

This being the case, in our previous research we applied a methodological approach in which both individual qualification strategies and their use or misuse by the firms of successive insertion would clearly appear and be made operative. In these terms, individual longitudinal qualification strategies are depicted as the outcomes of the dynamic interplay between the demand and supply sides of qualifications and occupational skills along life cycles.

Let's consider now one last but not least important line of criticism. Most of the more recent developments both in human capital and life cycle theories do not allow for economic upturns and downturns consideration.

It becomes now clear that differences in employment/unemployment spells and magnitudes, as well as the corresponding probabilities which exert a decisive impact on the individuals employment and upgrading strategies and chances, are strongly affected by economic cycles through the changing in practices and strategies firms and other employer organisations set in motion in response to cycles and moving economic environments.

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<sup>8</sup> Of course, we are fully aware that this was not the purpose for which Quadros de Pessoa have been designed. Nevertheless, as there is not by now a more adequate database for the study of skills dynamics, Quadros de Pessoa are quite often used for this purpose.

To analyse the impact of economic cycles on skill dynamics we must address some other theoretical fields such as job search and matching theories.

The hypotheses under job search theories emphasize differences in alternative jobs' wages and or working schedules, thereby deriving differences in workers' utility and search effort, for a given level of information on labour market opportunities. Some developments also pay attention to unemployment/vacancies ratios, or matching functions, on the line of the Beveridge functions and adjustments.<sup>9</sup> Although these latter approaches go a step further by taking into consideration labour market evolution and employment opportunities through the economic cycles, they generally fail to derive a robust approach on the impact of these cycles on skills dynamics because:

- Workers' decisions in their job search are only supposed to depend on the expectation of an higher wage income/lower working schedule in the next job and don't pay attention to human capital development strategies, either from the demand or supply side, impact on workers' utility;
- The mismatch between unemployment/vacancies ratio caused by the growing unadjustment between skills offered and skills demanded in the labour market.

Therefore, duration models which assess the impact of skill dynamics on life cycle trajectories, namely on the probability of getting a job after an

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<sup>9</sup> See, for instance, (Blau, 1991) and (Pissarides, 1992).

unemployment spell as well as on the duration of the unemployment spell itself, seem to be a more convenient approach.

Indeed, skills dynamics and labour market transitions are more and more contingent on the possibility of being depicted throughout instantaneous probability measures, given the highly turbulent framework in which transitions actually take place. This feature strongly advises the use of models which allow for the study of skills dynamics under a continuous perspective.

Following Bollens and Nicaise (1994) the duration models assume  $T$  – the duration of a spell as a random variable with distribution  $F(t) = P(T \leq t)$  and the survivor function  $S(t) = P(T \geq t)$  or the equivalent hazard function  $h(t) = f(t)/S(t)$  where  $f(t)$  is the density of  $T$ . Quoting Bollens and Nicaise (1994) the hazard function “represents the instantaneous probability of leaving unemployment at time  $t$ , given the individual was unemployed up to time  $t$ ”.

Using a proportional hazards model and the Weibull specification for the baseline hazard the survivor function can be written as:

$$h(x, t) = \alpha t^{(\alpha-1)} \cdot e^{x\beta}$$

Where:  $\alpha$  - parameter that indicates duration dependence from the time profile of the hazard which is identical to all individuals;

$x$  - Vector of individual's characteristics (sex, age, human capital variables – both supply and demand factors);

$\beta$  - Individuals' characteristics parameters.

Duration dependence will be negative if  $\alpha < 1$ , positive if  $\alpha > 1$  and there will be no duration dependence if  $\alpha = 1$ .

The important question is whether the time profile of the hazard that is identical for all individuals can be interpreted as representing the economic conjuncture meaning that the duration of unemployment spells and the probabilities of getting out of unemployment are negatively affected by economic downturns and positively affected by economic upturns. If that is so, duration models could be used to go further in the research of skill developments along the life cycle and their impact on life cycle trajectories.

### 3. SURVEY OF PREVIOUS RESEARCH RESULTS

From the research we have been doing since 1999 centered on the processes of reinforcement or obsolescence of qualifications and skills along the life cycle, some results are worth mentioning as marks of the path we have been following in the analysis of the present research subject.

Among the main outcomes from our first study on workers' life cycle trajectories [OEFP, 2000] are:

- Frequency of life cycle trajectories characterized by a great number of breakdowns towards employment is high;
- Frequency of those trajectories with returns to schooling after the labor market insertion, be it along employment or in unemployment /inactivity spells is also high;

- Vocational training programs attendance is becoming more and more frequent along life cycles as a strategy against precariousness, specially for the more mobile workers;
- Evidence of meaningful ‘poaching’ effect also appeared: therefore, destination firms will often profit from vocational training co-financed by previous employers;
- Under utilization or misuse of individual skills reinforcement by firms is associated with low job complexity;
- Firms’ career and promotion policies, as well as wage policy and reward systems most often don’t take into consideration human capital developments by workers.

From these results, it seemed interesting to construct a typology of life cycle trajectories and to search for both their most significant determinants and the effect of these determinants on the choice probabilities of upgrading or downgrading trajectories.

In Leão Fernandes, G. and Margarida Chagas Lopes (2002) the results of the estimation of a multinomial logit model considering as explanatory variables both demand and supply side variables showed that:

- Age and sex seem to be irrelevant in the choice of the trajectory;
- A significant impact on the choice probabilities of the demand side (sector) variables as well as supply side (schooling level) variables;
- Sector of first job – agriculture, quite frequently - has a negative effect on the probability of choosing an upgrading trajectory;

- Schooling level has a positive effect on the choice of upgrading trajectories, according to Weiss theoretical hypothesis;
- The above mentioned schooling level positive effect is associated to relatively low schooling levels thereby confirming the idea of the existence of low degrees of job complexity in the workplace.

Trying to go deeper into the interaction between job complexity, measured by a variable representative of the time workers need to become acquainted with on the job specific occupational skills, and both human capital development and utilization, a discriminant analysis results pointed to an association between successive jobs complexity and:

- Sector of first job and human capital utilization by firms;
- The worker's age and educational level when he first joined the labor market and formal education increasing along the life cycle.

These results confirm that job complexity is mostly determined by demand factors like the organization and work contents and workers competences utilization, as well as some supply side factors like human capital endowments.

So far, using data from the first survey on life cycle trajectories ever made in Portugal, we analyzed individual longitudinal qualification strategies as outcomes of the dynamic interplay between the demand and supply sides of qualifications and occupational skills along the life cycle.

To proceed further in the study of life cycle trajectories determinants we would like to study how economic cycles affect



employment/unemployment spells and magnitudes as well as the corresponding probabilities. That is where we are now and that is where our problems in getting appropriate data begin.

#### 4. DATABASE REQUIREMENTS DISCUSSION

We shall consider now databases requirements in order to be able to tackle with skills dynamics.

Despite other possible improvements, in order to support either duration models or survival functions and to take into consideration employment and transition spells along life cycles, the best suitable data will consist in individual life cycle trajectories. As a matter of fact, most studies which are being developed nowadays on the interaction between qualification strategies and work stories use longitudinal data.

Such data should consider individual characteristics, such as gender, age, formal schooling, namely school achievement, but also scholar choices (general *versus* vocational) and main qualification domains<sup>10</sup>.

Then, longitudinal data should consider for both employment and unemployment/inactivity spells some leading indicators, namely:

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<sup>10</sup> Actually, one of the huge limitations in most data on employment qualification has to do with the enormous difficulty in separating formal schooling from vocational training impacts on employees' productivity and labour market qualification. See, for instance, (de la Fuente and Domenéch, 2002).

- Beginning and ending time for each kind of occurrence (employment /transition) should be rigorously dated;
- Schooling level and formal training attendance indicators, both previous to labour market insertion and at the beginning and by the ending of each occurrence – thereby, allowing to assess eventual schooling improvements or training attendance during both employment and transition spells;
- For each of the employment spells, an accurate characterisation of industry, functional area inside organisation, occupational and wage levels, degree of worker skills and qualifications utilisation by firms, and other indicators relevant to address each job/employment skills demanding;
- For each of the transition spells, a robust characterisation of the reasons for job changing (if pertinent), reemployment strategies specially those concerning human capital investments.

In the database gathered from the OEFP 1999 inquiry on workers' occupational, sectorial and regional mobility already mentioned, workers were asked to characterize each one of the successive jobs along their life cycles. As qualification and skills indicators are of major importance in any analysis of life cycle trajectories, special attention has been given to the investigation of any potential or actual increase in formal schooling or attendance of any vocational training programmes, which might have taken place in the individual trajectories during employment or transition spells. Special attention has also been given to the influence of workers human capital developments on job complexity, responsibility levels and reward policies inside firms.

The fact that the mentioned inquiry is not a real longitudinal one, meaning that information about employment and transition spells along the life cycle was gathered in a unique moment of time and not in several moments along the life cycle made it contingent on the memory effort of the inquired. This was the main cause for the failure in fitting an adequate status metric to this database. It proved to be very difficult to remember the dates of beginning and ending of each one of the employment and transition spells, especially for the more mobile trajectories and for the larger life cycles.

The number of missings in the data related to the status metric unabled us to use this database to proceed our research by applying a duration model framework, as we intend to do from now on.

The *Quadros de Pessoal* database gathered by the DETEFP – Ministry of Social Security and Employment despite being of capital importance for most of the research purposes concerning labour market analysis and the characterisation of labour market qualification structure in a given period of time, doesn't seem adequate for our purpose.

First of all, *Quadros de Pessoal* is not a longitudinal survey and so it is difficult to follow each worker's trajectory along life cycle. It is true that with some effort this difficulty can be overcome, with the cost of significantly sliming the number of observations available, but even then only information about employment spells is available. Likewise workers' activities during transition spells cannot be traced out. This is the most

obvious limitation of *Quadros de Pessoal*, as well as any other administrative employment record, regarding data needs for adequately assessing skills dynamics.

Evidence of the above mentioned drawback are the share of ‘Dirigentes’ who have roughly achieved basic education, the difficulty for most lower secondary (compulsory) education graduates to overcome the semi-skilled threshold (Pessoal Semi-qualificado), or the fact that to a same real qualification level (school achievement combined with identical vocational training attendance and/or occupational experience) should quite probably be assigned different occupational levels in small and large size firms.

Thereby, despite a quite strong correspondence existing between these occupational levels and firms’ wage structures<sup>11</sup>, neither of them can stand for a good proxy of individuals’ real qualification or skills, nor can either of them adequately indicate each one’s productivity.

Another limitation regarding *Quadros de Pessoal*, is the fact that they are representative of ‘regular’ employment only and collected through forms which most (but not all<sup>12</sup>) firms have to fill and address to the Ministry of Labour once a year. This means that most short spell occupations, most temporary infra annual work, risk failing to be registered unless for contracts at stake in October when records have to be filled.

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<sup>11</sup> We have adjusted this correspondence for different years, using *Quadros de Pessoal* data, and found strong evidence that the occupational level plays the major role in determining wage among a set of variables such as human capital indicators, individual characteristics and institutional variables (Chagas Lopes, 1995).

<sup>12</sup> The agriculture sector is badly covered and Civil Service/Public Administration is not covered at all.

In this line, most criticism has recently been addressed towards Employment Records (as *Quadros de Pessoal*) on the grounds that a large portion of job-to-job and job-to-unemployment transitions are actually taking place more frequently than once a year (Bigard and Guillotin, 1994; Royalty, 1998).

Furthermore, although *Quadros de Pessoal* includes a quite complete set of questions about workers' and firms' characteristics during employment spells, it lacks information about job technological and organisational complexity which would allow us to characterize workers' skills use or misuse by firms, the nature of occupational experience each worker derives from successive occupations and vocational training promoted by each successive employment, as well.

## 5. FURTHER RESEARCH DEVELOPMENTS AND POLICY IMPLICATIONS

As we have previously referred, our research programme sets the objective of applying duration models for skills dynamics assessing and we are now trying to obtain an appropriate database.

In further research developments, we hope to be able to support such policy implications as:

- Assessing and evaluating both ‘2<sup>nd</sup>. chance education’ and vocational training programmes for the adult employed population; this information should help decision makers to determine the extension of the needs in vocational training and other qualification programmes able to compensate for separation spells obsolescence;
- Improving fine tuning of infra annual flows assessment, be them job-to-job and job-to-unemployment/inactivity and vice-versa, on the basis of a more accurate set of turnover indicators.

Furthermore, this approach by allowing to forecast after cycle (re)employment probabilities will enable decision makers to address such features as:

- Higher education graduates’ (re)employment and the corresponding job-matching quality;
- Possible ‘chimney effects’<sup>13</sup> and the corresponding reinforcement in the eviction of bottomline qualifications which affects long term unemployment and thereby histeresis intensity.

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<sup>13</sup> See, for instance, Heijke and Muysken (eds.), (2000) or Ehrenberg and Smith (2003).

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